Ministry of Economic Development
Manatū Ōhanga
Intellectual Property Office of New Zealand

PCT/NZ03/00253

CERTIFICATE

This certificate is issued in support of an application for Patent registration in a country outside New Zealand pursuant to the Patents Act 1953 and the Regulations thereunder.

I hereby certify that annexed is a true copy of the Provisional Specification as filed on 28 March 2003 with an application for Letters Patent number 525019 made by DAVID ARTHUR LEE and ARTHUR MATHEWSON LEE.

Dated 25 November 2003.

PRIORITY DOCUMENT
SUBMITTED OR TRANSMITTED IN COMPLIANCE WITH RULE 17.1(a) OR (b)

Neville Harris
Commissioner of Patents, Trade Marks and Designs

COMMISSIONER OF PATENTS, TRADEMARKS & DESIGNS
NEW ZEALAND

330 High Street, Lower Hutt and 17 Toop Street, Seaview
PO Box 30687, Lower Hutt, New Zealand or DX SX 11129, Wellington

NEW ZEALAND

PATENTS ACT, 1953

PROVISIONAL SPECIFICATION

APPARATUS FOR PRODUCING A YARN

We, **DAVID ARTHUR LEE and ARTHUR MATHEWSON LEE**, both New Zealand citizens, of 177 Maces Road, Christchurch, New Zealand, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement.

35707-1

FIELD

The invention comprises apparatus for producing a yarn, which is adapted to be able to vary the degree of twist along the yarn or the twist profile of the yarn.

BACKGROUND

In producing a wool yarn, or a yarn which is formed predominantly of wool, a number of wool slivers may, typically after drafting, be passed through a twisting stage which comprises reciprocating rotating rollers which move from side to side as the wool slivers pass between the rollers, thereby imparting a twist to the strands. After exiting the twist rollers, the strands are brought together to twist naturally with each other to form a multi-ply yarn.

New Zealand patent 336048 discloses a method for producing a yarn comprising three or more slivers, or ends, in which the three slivers are passed between reciprocating twist rollers and then one or more of the slivers is passed over a path of a different length before the slivers are brought together. Rather than all of the slivers or ends passing through the twisting stage together and then being twisted naturally together, the twist in one or more of the slivers or ends is staggered or out of phase relative to the twist in the other slivers.

SUMMARY OF INVENTION

The present invention provides an improved or at least alternative apparatus for producing a yarn comprising a plurality of twisted strands.

In one aspect the invention broadly comprises apparatus for producing a yarn including a first reciprocating twisting stage adapted to simultaneously twist one or more slivers to produce one or more twisted strands and including one or more rollers arranged to move reciprocally along the axis of rotation of the roller(s) to impart twist to the sliver(s) followed by a second (and optionally further) reciprocating twisting stage also adapted to

simultaneously twist the slivers and including one or more roller(s) also arranged to move reciprocally to impart twist to the slivers.

Preferably the apparatus includes a control system which enables control of any one or more of the transverse speed, the extent of the transverse movement or throw, and the rotational speed of the one or more rollers of the two (or more) reciprocating twisting stages, to achieve the desired degree of twist or twist profile in the strands of the yarn. Preferably the apparatus includes an associated control system including a microprocessor, PLC, or similar which controls the transverse movement or throw, and/or the speed of transverse movement, and/or the rotational speed of each reciprocating twisting stage and/or which enables a user to programme the degree of twist or twist profile to be imparted to a production run, series of production runs, or part run.

Typically the yarn will be formed from wool or predominantly wool, but alternatively the invention may be used for producing synthetic yarns or predominantly synthetic yarns, typically from a synthetic staple fibre.

BRIEF DESCRIPTION OF THE DRAWINGS

Forms of apparatus of the invention are described with reference to the accompanying drawings by way of example and without intending to be limiting, wherein:

Figure 1 schematically shows one form of apparatus of the invention from above,

Figure 2 shows the apparatus from one side, showing the drafting unit and twisting rollers thereof,

Figure 3 shows the strands exiting the twisting rollers being brought together by guides, and

Figure 4 schematically shows one system for driving the twist rollers.

DETAILED DESCRIPTION OF PREFERRED FORM

Referring to Figure 1 the preferred form apparatus comprises a drafting unit 5 comprising opposed moving preferably rubber coated rollers or belts, between which the fibres pass (as slivers). In the example shown, three slivers (unspun) of for example wool drawn from drums or other bulk supply (not shown), are fed between rollers 4 and through the drafting unit 5 and are drawn out - typically the thickness of the wool fibre assembly is reduced to between one half to one twenty-fifth of the initial thickness. The amount of thickness reduction may be adjusted by altering the rotational speed of the drafting unit.

A first reciprocating twisting stage 6A comprises a pair of rollers 6a and 6b (see Figs 2 and 3), one or both of which rotate as well as reciprocate back and forth across the direction of movement of the strands as the apparatus operates. The twist rollers 6a and 6b impart twist in one direction as the roller(s) move(s) one way followed by twist in another direction as the roller(s) move(s) the other way in operation. Alternatively a single reciprocating roller may move relative to a flat surface over which the strands pass, to twist the strands between the roller and surface.

A second reciprocating twisting stage 6B comprises a second pair of rollers 6c and 6d one or both of which rotate as well as reciprocate back and forth across the direction of movement of the strands as the apparatus operates. The twist rollers 6c and 6d also impart twist in one direction as the roller(s) move(s) one way followed by twist in another direction as the roller(s) move(s) the other way in operation. Alternatively again a single reciprocating roller may move relative to a flat surface over which the strands pass, to twist the strands between the roller and surface.

Areas of non-twist tend to be formed in the strands at the point at which the first pair of roller(s) change(s) direction. Transverse movement of the second pair of twist rollers is synchronised but out of phase with transverse movement of the first pair of rollers, so that the second roller pair will apply twist to the areas of non-twist in the strands which occur at the points in the strands where the first roller pair changes transverse direction.

The extent of the transverse reciprocating movement or throw of the rollers 6a and 6b, and 6c and 6d, may be varied to achieve the desired degree of twist in the strands or twist profile of the yarn, as will be further described with reference to Figure 6. Additionally or alternatively the desired degree of twist may be obtained by varying the rotational speed of the twist rollers. Additionally or alternatively again the degree of twist or twist profile may be varied by adjusting the speed of reciprocating the transverse movement of the twist roller(s) (relative to their rotational speed). The variation in the speed of transverse movement and/or throw and/or rotational speed of the twist roller(s) may be controlled by a microprocessor-based control system. A user may programme roller speed, the extent of roller transverse movement, and the rate of roller transverse movement, for any production run to achieve a desired twist profile in the strands or resulting multi-ply yarns.

Referring to Figure 4, in the arrangement shown electric motors 7a and 7b drive rotation of the twist rollers 6a and 6b. A similar arrangement may be provided for rollers 6c and 6d. The rotational speed of the rollers and may be varied by varying the speed of the electric motors 7a and 7b, to vary the degree of twist in the strands of the yarn. The speed of the roller drive motors may be constant for a production run or may be controlled by a user programmed microprocessor to vary during a production run, or over a series of production runs.

Electric motor 9 such as a servomotor drives the reciprocal movement of the twist rollers, and maybe controlled to vary the extent of reciprocal transverse movement or the throw of the twist rollers. Servomotor 9 or gear drives a pulley or sprocket (not shown) which rotates and counter rotates and is connected to cable or chain 14 which extends about pulley or gear 13. Cable or chain 15 also extends about pulley or gear 13 and is connected at one end to shaft 16a and at the other end to shaft 16b, via swivels or similar. Rotation and then counter rotation of the output of the motor 9 drives the cable 15 and thus the twist rollers 6a and 6b back and forth with a reciprocal movement. That is, movement of cable or chain 14 in an anti-clockwise direction by servomotor 9 will cause cable or chain 15 to move in an anti-clockwise direction and roller 6a to move in the transverse direction shown in Figure 6 and roller 6b to move in the opposite direction, as shown, and vice versa when servomotor 9 reverses its direction. The twist roller shafts 8a and 8b attach to cable or chain 11 at their

other ends, which passes about pulley or gear 12, via swivels or similar. The extent of the lateral movement or throw of the rollers correlates to the degree of twist in the strands of the yarn, i.e. a greater lateral movement of the rollers will result in a higher degree of twist in the strands (for a given roller rotation and speed), and vice versa.

A similar arrangement may drive transverse movement of the rollers 6c and 6d but with the transverse movement non-synchronised, so that for example when the rollers 6a and 6b are at the outer most extent of their transverse movement and are changing transverse direction, the rollers 6c and 6d are midway through their transverse movement.

The rollers maybe mounted for rotational movement and reciprocating side movement by the roller shafts 8a and 8b passing through slide bearings 10 on one or both sides (shown on one side only – the right hand side of Fig 6) or similar. The roller shafts 8a and 8b may pass slidingly through electric motors 7a and 7b which drive the rollers while also allowing for the sideways reciprocal movement of the rollers/roller drive shafts.

Variation in the throw and/or rotational speed of the twist rollers may be achieved without the use of servomotors by using other suitable equivalent mechanical or electro-mechanical means without departing from the scope of the invention.

Referring to Figure 3 following both reciprocating twisting stages, to produce one form of yarn one or more of the strands is led directly through primary guide or eyelet 1b, while the other strands are led through secondary guides or eyelets before also passing through primary guide 1b, so that some strands have a different path length before entering primary guide 1b. Strand 2 passes through guide 2b whilst strand 3 passes through guide 3b before both passing through primary guide 1b. As the strands exit the eyelet 1b they tend to self-twist together, or alternatively, a further twisting mechanism may optionally be provided to assist in twisting the three (or more) strands together to form the finished yarn. Such a further twisting mechanism may be controlled to enable the extent to which the individual strands are twisted together to be varied ie to enable control of the "twist within the twist" of the yarn.

In a further embodiment, the apparatus of the invention may be capable of adjusting the position of the guides or eyelets or their mechanical equivalent, which bring the individual strands together, to vary the point of overlap or relative phase of the strands. For example the guides 1b, 2b and 3b or equivalent may be mounted to a geared track carried by transverse mounting bar 10 in Figure 3, and each have a small associated electric motor which may be driven to move the guides, one or more at a time, along the mounting bar 10. The adjustment of the eyelets, or their equivalent, may be controlled by a microprocessor-based control system.

Typically the yarn will be formed from wool or predominantly wool, but alternatively the invention may be used for producing synthetic yarns or predominantly synthetic yarns, typically from a synthetic staple fibre.

The foregoing describes the invention including a preferred form thereof. Alterations and modifications as will be obvious to those skilled in the art are intended to be incorporated within the scope hereof.

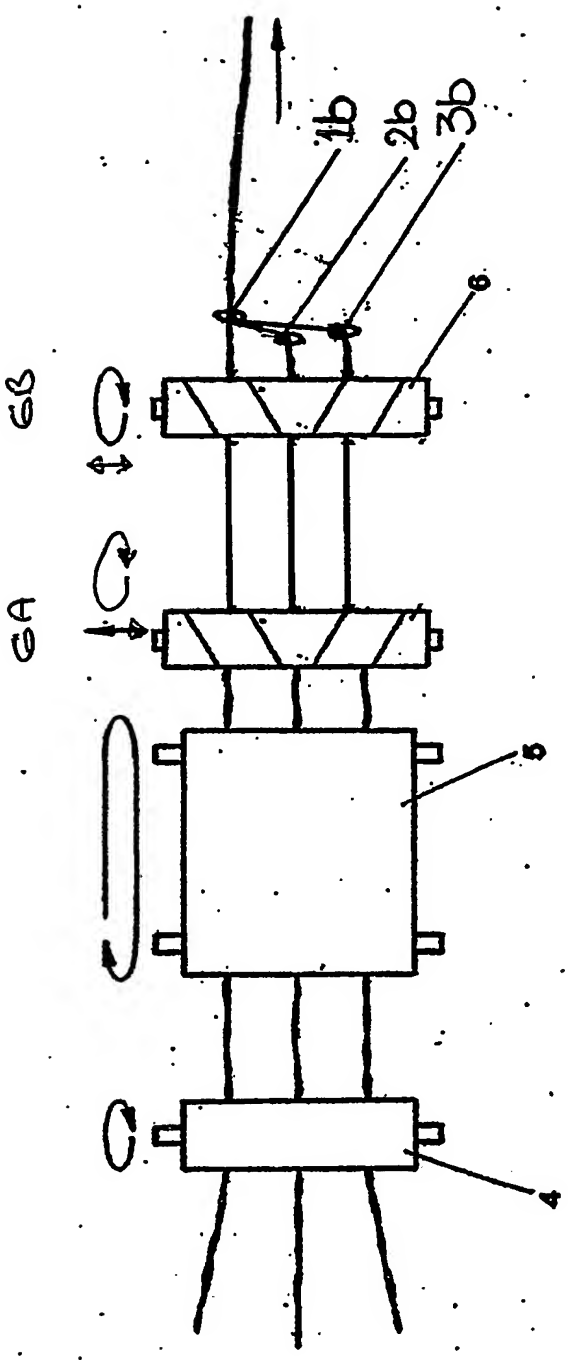

FIGURE 1

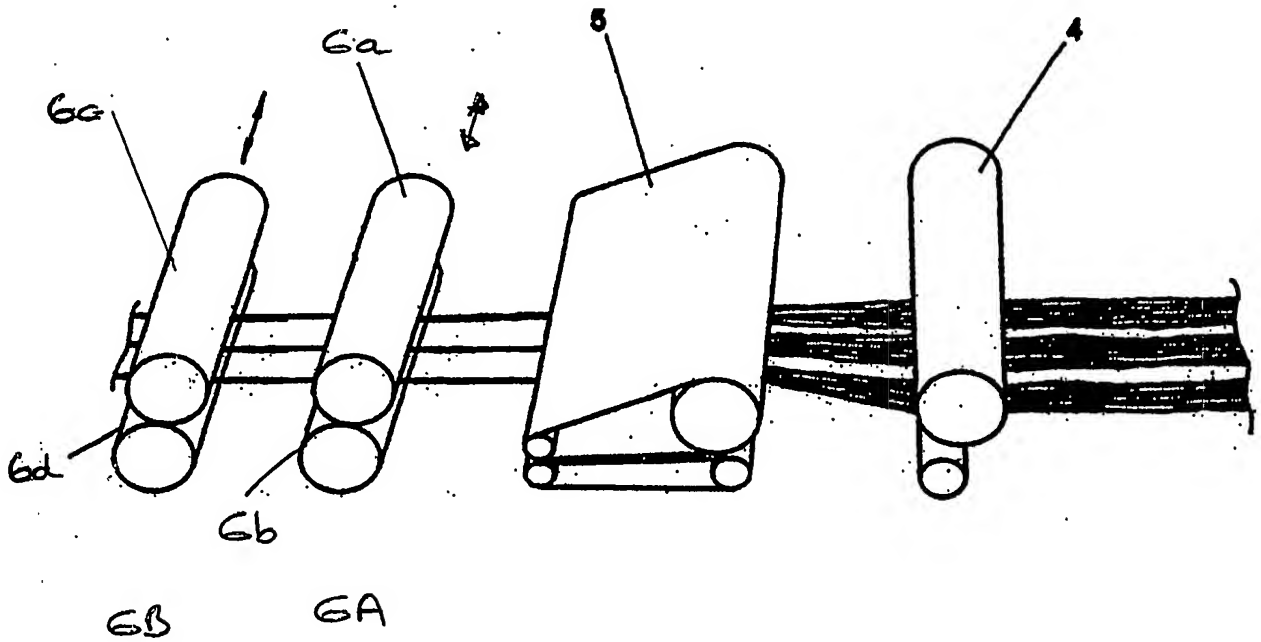

FIGURE 2

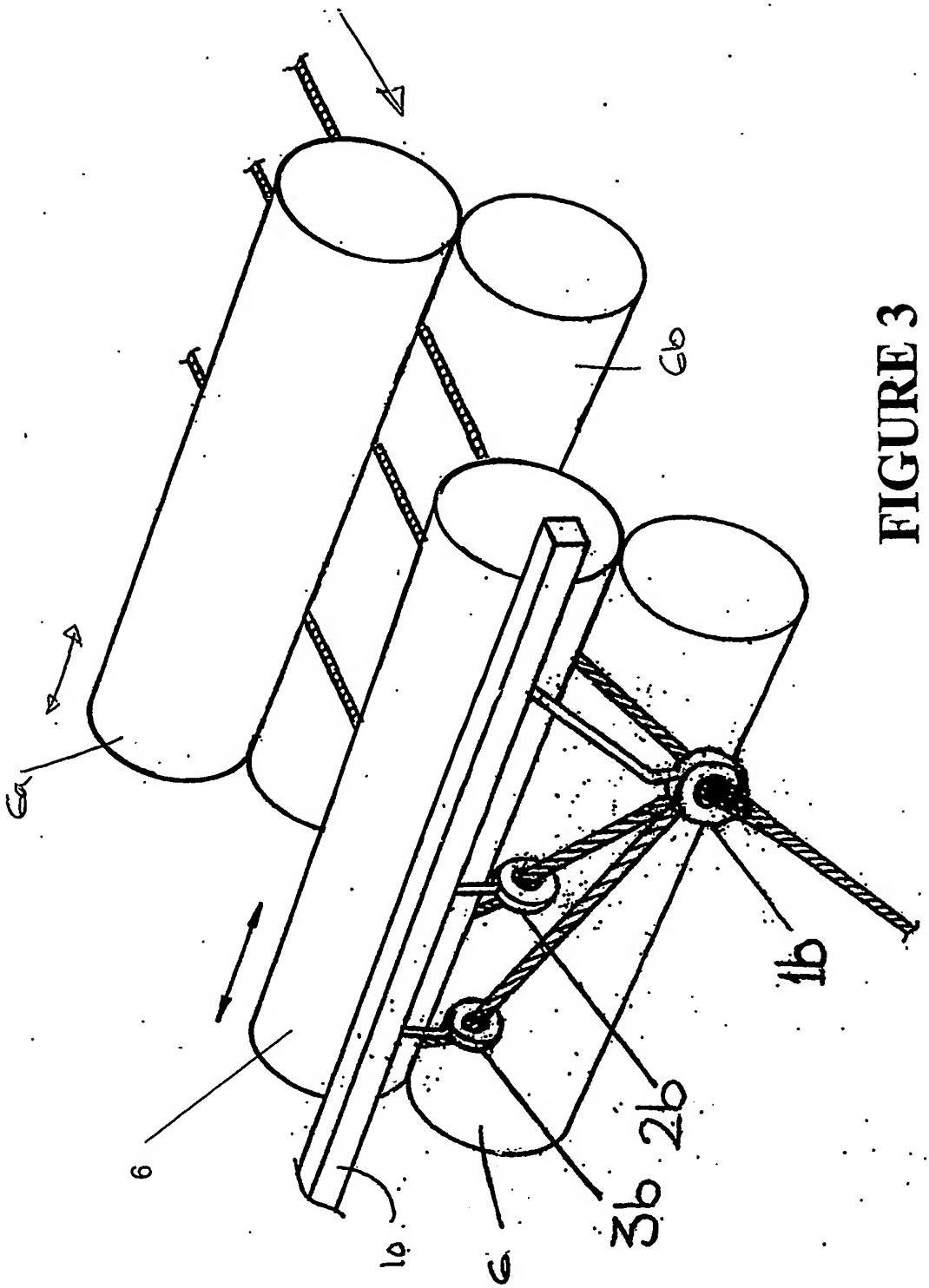

FIGURE 3

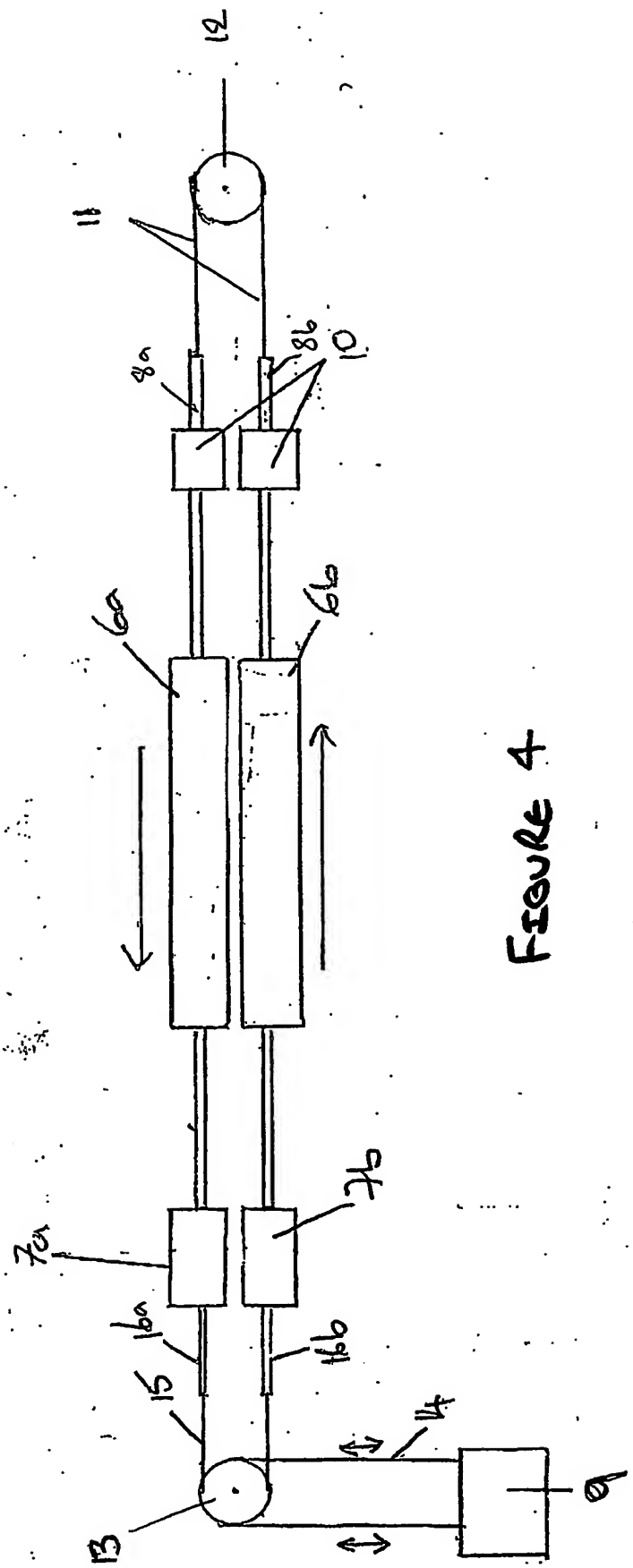

FIGURE 4